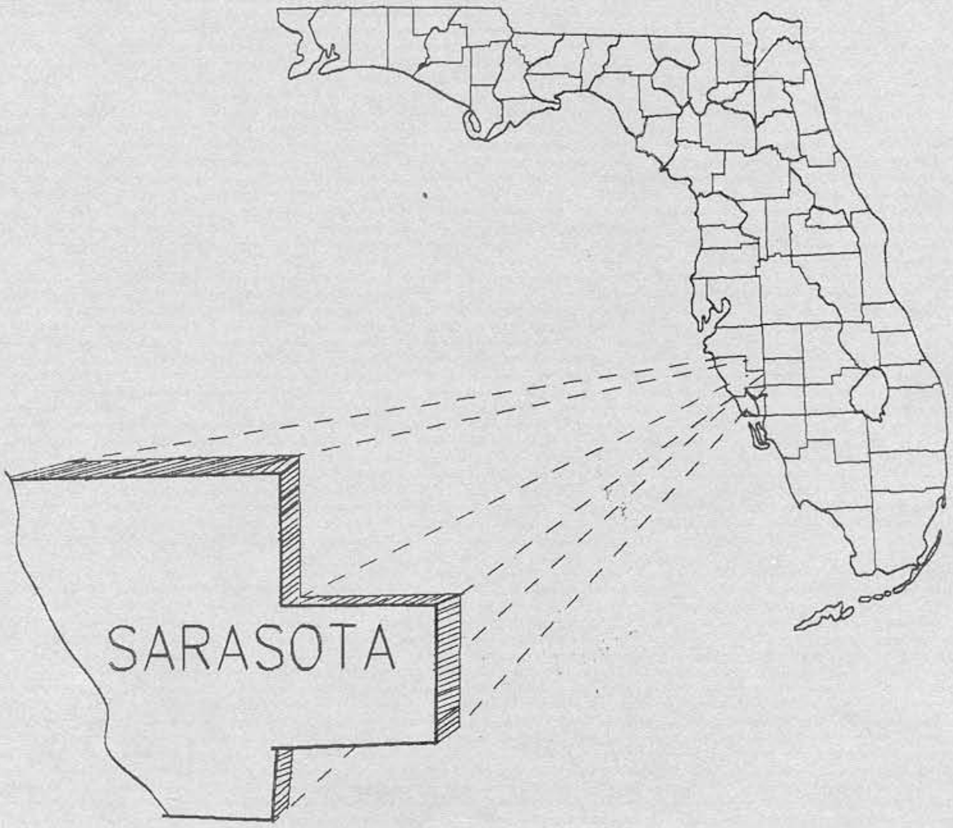
T. SHOOPMAN

ELLIGRAW BAYOU

FLOOD PLAIN MANAGEMENT STUDY

SARASOTA COUNTY, FLORIDA



Prepared by:

United States Department of Agriculture
Soil Conservation Service
Gainesville, Florida

In Cooperation with:

Sarasota County
and
Sarasota Soil and Water Conservation District
April 1993

ELLIGRAW BAYOU
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March 1993

United States Department of Agriculture

Soil Conservation Service

Federal Building, Room 248
401 Southeast First Avenue
Gainesville, FL 32601-6849

April 14, 1993

Mr. T. A. Shoopman, P.E.
Planning Engineer
Stormwater Management
1301 Cattlemen Road
Sarasota, Florida 34232

Dear Mr. Shoopman:

Enclosed for your information and use is a copy of the *Flood Plain Management Study Technical Report for Elligraw Bayou, Sarasota County, Florida*.

Also enclosed are two copies of the HEC-1 and HEC-2 data sets used for the study along with two printed copies of the HEC-1 and HEC-2 output.

If you have any questions, please contact my office at (904) 377-0963.

Sincerely,

Kenneth J. Haul, for

T. Niles Glasgow
State Conservationist

Enclosures

cc: Jesse T. Wilson, SCE
Ken Murray, NRPP Coordinator

CONTENTS

Page

INTRODUCTION....1
Requesting and Participating Organizations....1
Study Authorities....2
Study Objectives....3

DESCRIPTION OF STUDY AREA....4
Location....4
Stream System....4
Climate....7
Physiography....9
Stratigraphy.... 9
Soils.... 9
Natural Values....13
Land Use and Development Trends....16

FLOOD PROBLEMS....17
Flood Potential....17
Flood Tables....19
Flood Profiles....20
Flood Hazard Maps....20

FLOOD PLAIN MANAGEMENT ALTERNATIVES....21
Nonstructural Measures....21
Structural Measures....22

STUDY RESULTS AND RECOMMENDATIONS....24

GLOSSARY OF TERMS....26

BIBLIOGRAPHY....29

APPENDIX A (Investigation & Analysis)....31

APPENDIX B (Data Table)....35

APPENDIX C (Flood Profiles)....38

APPENDIX D (Typical Valley Cross Sections)....45

APPENDIX E (Flood Hazard Maps)....48

LIST OF TABLES

Table		Page
1.	Streams and Drainage Area	5
2.	Temperature and Precipitation Data	8
3.	Threatened and Endangered Species	15
4.	Rainfall Frequencies and Depths	18
5.	1-Hour Rainfall Totals for June 23-26, 1992	19

APPENDIX B

Discharge - Elevation - Frequency Data for:

6. Elligraw Bayou....................................36
7. Elligraw Lateral 1..................................37

LIST OF FIGURES

Figure		Page
1.	Watershed Location Map	6
2.	General Soils Map	11
3.	General Soils Map...(continued)	12

APPENDIX C - Flood Profiles

4.	Elligraw Bayou Flood Profile Index	39
5.	Elligraw Bayou Flood Profile Index...(continued)	40
6.	Elligraw Bayou	41
7.	Elligraw Lateral 1	42
8.	Elligraw Bayou, June 1992	43
9.	Elligraw Lateral 1, June 1992	44

APPENDIX D - Typical Valley Cross Sections

10.	Elligraw Bayou, Cross Section #200	46
11.	Elligraw Lateral 1, Cross Section #11060	47

APPENDIX E - Flood Hazard Map

12.	Flood Hazard Map	49
13.	Flood Hazard Map	50

INTRODUCTION

The information presented in this report was developed for use by local decision-makers and the public in making land use and flood plain management decisions within the study area (see Figure 1). It is hoped that this information will assist local planning councils or commissions with development decisions in such a way that future intensive rainfall events will result in minimal inconvenience to residents of the area.

Sarasota County, Florida, is experiencing rapid population growth with accompanying demands on land resources. This study area can be expected to continue to undergo rapid growth in the near future. Both natural streams and excavated channels in the study area were modeled to determine the hydraulic and hydrologic effects of existing land use.

Requesting and Participating Organizations

The Sarasota Soil and Water Conservation District requested a Flood Plain Management Study of Elligraw Bayou in 1987. This study was conducted in accordance with a plan of work developed in 1987 and revised in 1991 by the USDA Soil Conservation Service (SCS) and the requesting local authorities. At that time, SCS met with the sponsors to review the intensity of this study. The study includes hydrologic and hydraulic information on Elligraw Bayou.

The Southwest Florida Water Management District provided aerial photomaps of the study area with one-foot interval contour lines. Sarasota County assisted the SCS in obtaining cross section surveys and measurements of bridges and culverts.

Study Authorities

The SCS is authorized to provide technical assistance to federal, state, and local governing bodies in the development, revision, and implementation of their flood plain management programs by carrying out flood plain management studies (FPMS's) in accordance with Federal Level Recommendation 3 of "A Unified National Program for Flood Plain Management," and Section 6 of Public Law 83-566. This is in accordance with Recommendation 9(c) of House Document No. 465, 89th Congress, 2nd Session; Executive Order 11988 dated May 24, 1977; and USDA Secretary's Memoranda 1606 and 1607.

These studies are coordinated in accordance with the December 1978 Joint Coordination Agreement between the SCS and the Florida Department of Community Affairs. The Department Secretary, under the direction of the Governor of Florida, is responsible for receiving requests, setting priorities, and coordinating flood plain management studies conducted by the SCS and other state and federal agencies.

Study Objectives

The 1985 Growth Management Act (Local Government Comprehensive Planning and Land Development Regulation Act) which amends the Local Government Comprehensive Planning Act of 1975 (Chapter 163 of Florida Administrative Code) requires counties to develop current and future land use maps including the identification of flood plains. The rules in Florida Administrative Code Chapter 9J-5.006 (Future Land Use Element) further call for an outline of how they intend to comply with these requirements and implement a flood plain management program.

The objective of this flood plain study is to furnish the sponsors detailed information in the form of field survey notes, field maps, computer output and input files (both hard copy and electronic media) and flood profiles. This information is intended to be used by the sponsors and other interested parties for the evaluation of the effects of proposed development in areas of the flood plains of the channels studied.

DESCRIPTION OF STUDY AREA

The study area consists of the 1.0 square mile Elligraw Bayou drainage basin (see Figure 1). The area studied is characterized by a complex system of natural channels and excavated channels. The area is experiencing rapid urban development in the upper watershed (above Beneva Road) because of its numerous desirable attributes and its proximity to the city of Sarasota.

Location

The study area is located in the central part of Coastal Sarasota County. Sarasota County is in southwest Florida, bordered by: the Gulf of Mexico to the west, Manatee County to the north, DeSoto County to the east and Charlotte County to the south. The study area is located within the United States Geological Survey's hydrologic unit 03100201.

Stream System

The stream system studied consists of both natural and excavated channels. The total length of channels studied is 2.3 miles with a drainage area of one square mile. Table 1 shows the streams studied, their identification, lengths, and respective drainage areas.

Table 1. -- Streams and Drainage Area

Streams	Drainage Area (sq mi)	Channel Length (ft)
Elligraw Bayou	0.87	9,450
Lateral 1	0.13	2,900

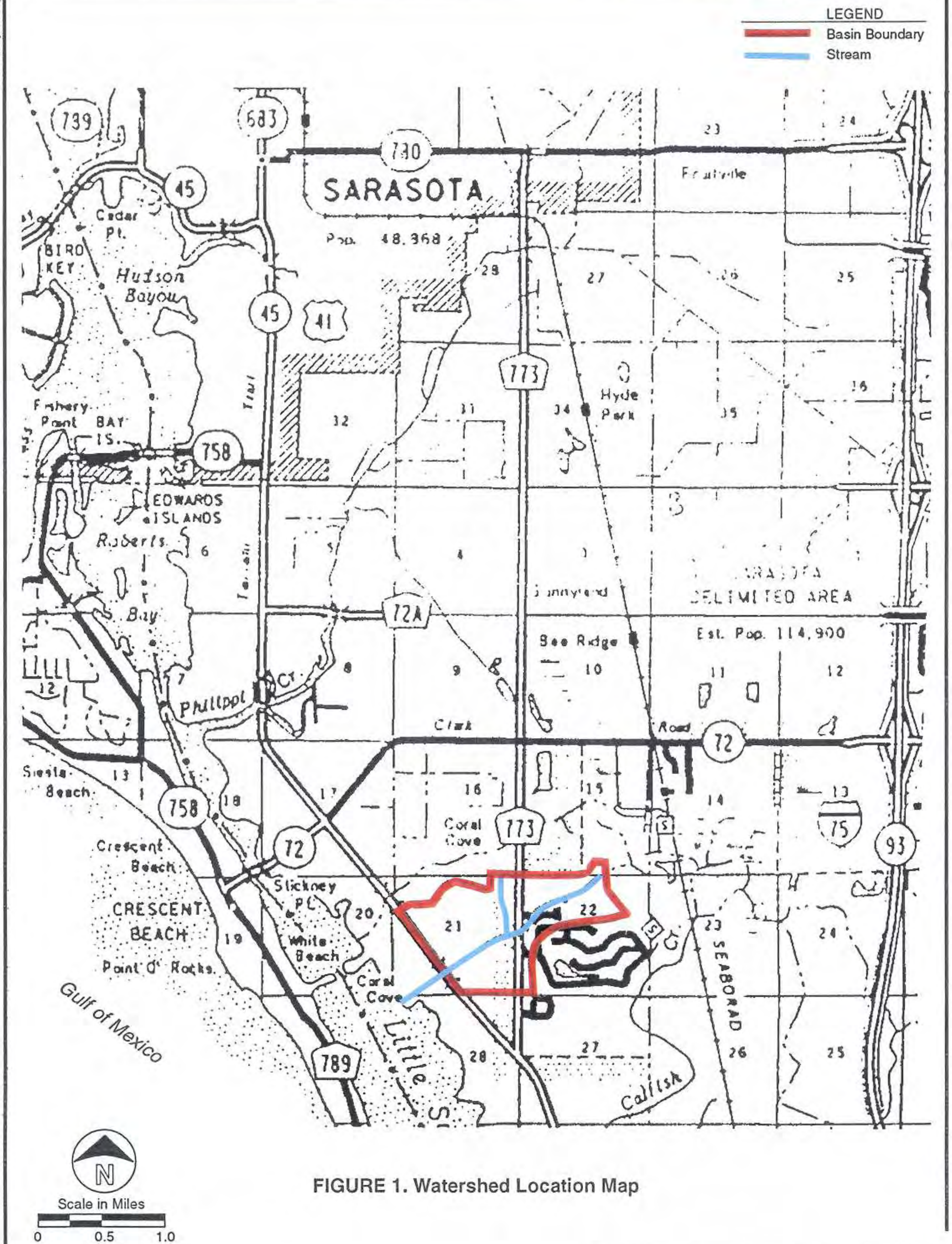

FIGURE 1. Watershed Location Map

SOURCE: DOT General Highway Map, Sarasota County, Florida, 1984.

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Climate

The climate of Sarasota County is oceanic and subtropical. The temperature is influenced by latitude, low elevation, winds that sweep across the peninsula, and the proximity to the Gulf of Mexico. The climate is characterized by high relative humidity, short mild winters, long warm summers, and rainfall that is abundant throughout the year with 60% occurring from June through September.

The climate is tempered by the Gulf of Mexico and landlocked bays, rivers, and creeks. The bodies of water protect the coastal areas from frost in winter. Thus, vegetables and citrus fruit can be grown with minimal risk.

Monthly temperature and precipitation data are shown in Table 2. The climate data shown is from Station No. 8021 located in Sarasota County, Florida.

Temperatures above 95° F occur frequently in summer. Such temperatures are of short duration because thunderstorms, which usually occur in the afternoon, quickly cool the air. Temperatures fall below the freezing point once or twice a year, generally in the eastern part of the county. Frost records kept at Sarasota over a 27-year period indicate that the latest killing frost in spring occurred on February 27 and the earliest one in autumn occurred on November 27. Some areas near bodies of water are frost free year round.

Table 2. -- Monthly Temperature and Precipitation Data

Month	Temperature						Precipitation			
				2 years in 10 will have				2 yrs in 10 will have		
	avg daily max	avg daily min	avg	max temp. >than	min temp. <than	avg no. of grow'n degree days*	avg (in.)	less than (in.)	more than (in.)	average number of days with 0.10 inch or more
January	73.5	51.6	62.5	84	27	638	2.16	0.69	3.52	3
February	74.2	52.6	63.4	85	32	652	3.00	1.21	4.52	4
March	77.6	56.2	66.9	87	37	829	3.25	1.06	5.05	4
April	82.3	60.5	71.4	92	44	927	2.35	0.62	3.88	3
May	86.7	65.8	76.2	94	53	1122	2.69	0.41	4.40	3
June	89.6	70.6	80.1	96	61	1191	6.46	3.61	8.98	8
July	90.7	72.3	81.5	96	66	1220	7.45	4.08	10.42	10
August	91.2	72.4	81.8	97	66	1274	8.86	5.47	11.92	12
September	90.1	71.3	80.7	95	63	1201	8.39	4.92	11.48	10
October	85.6	65.3	75.4	94	47	1094	3.13	0.75	5.00	5
November	79.1	56.8	67.9	89	35	833	1.81	0.54	2.84	2
December	74.6	51.8	63.2	86	30	717	2.32	0.80	3.58	3
Yearly :										
Average	82.9	62.3	72.6	----	----	----	---	---	---	---
Extreme	101	22	---	98	27	----	---	---	---	---
Total	---	---	---	----	----	11697	51.86	40.31	61.90	67

*A growing degree day is a unit of heat available for plant growth. It can be calculated by adding the maximum and minumum daily temperatures, dividing the sum by 2, and subtracting the temperature below which growth is minimal for the principal crops in the area (Threshold : 40.0 deg. F) (Soil Conservation Service - Climate Data Access Facility)

Physiography

All of the study area is in the Gulf Costal Lowlands. Elevations range from mean sea level along the coast and to a maximum of about 21 feet above sea level in the eastern part of the study area. Elevations increase almost imperceptibly from the west and southwest toward the northeast. The topography tends to be flat. The steeper areas are in the vicinity of streams and canals.

Stratigraphy

Sediments at or near the surface in Sarasota County consist of quartz sand, consolidated and unconsolidated shell beds, clay, limestone, and dolomite. These sediments range in age from Oligocene (38 to 22.5 million years ago) to Holocene (10,000 years ago to the present).

Soils

The dominant soils are nearly level and are poorly drained. Soil Association 1 (Association 3 in Sarasota County Soil Survey) comprises the soils in the study area as shown on the General Soils Map (Figure 2). In most areas the soils are sandy throughout and have a dark subsoil overlying a gray, loamy subsoil. In some areas they are sandy throughout and have a dark subsoil. In other areas they have a gray loamy subsoil.

Soil Association #1

EauGallie-Myakka-Holopaw-Pineda

Nearly level, poorly drained and very poorly drained soils that have a sandy surface layer and a sandy and loamy subsoil are sandy throughout, or have a sandy surface layer and a loamy subsoil

This map unit consists of soils on broad flatwoods interspersed with sloughs surrounding many depressions that are seasonally ponded. It is the dominant unit in the county, occurring in all areas, except for those very near the coast.

Most of the urban development in Sarasota County has taken place in areas of this map unit because of the better drainage of some of the soils. Other uses include pasture, range, and truck crops.

Additional information about the physiography, stratigraphy and soils of the study area may be obtained from the Sarasota County Soil and Water Conservation District.

FIGURE 2. General Soils Map

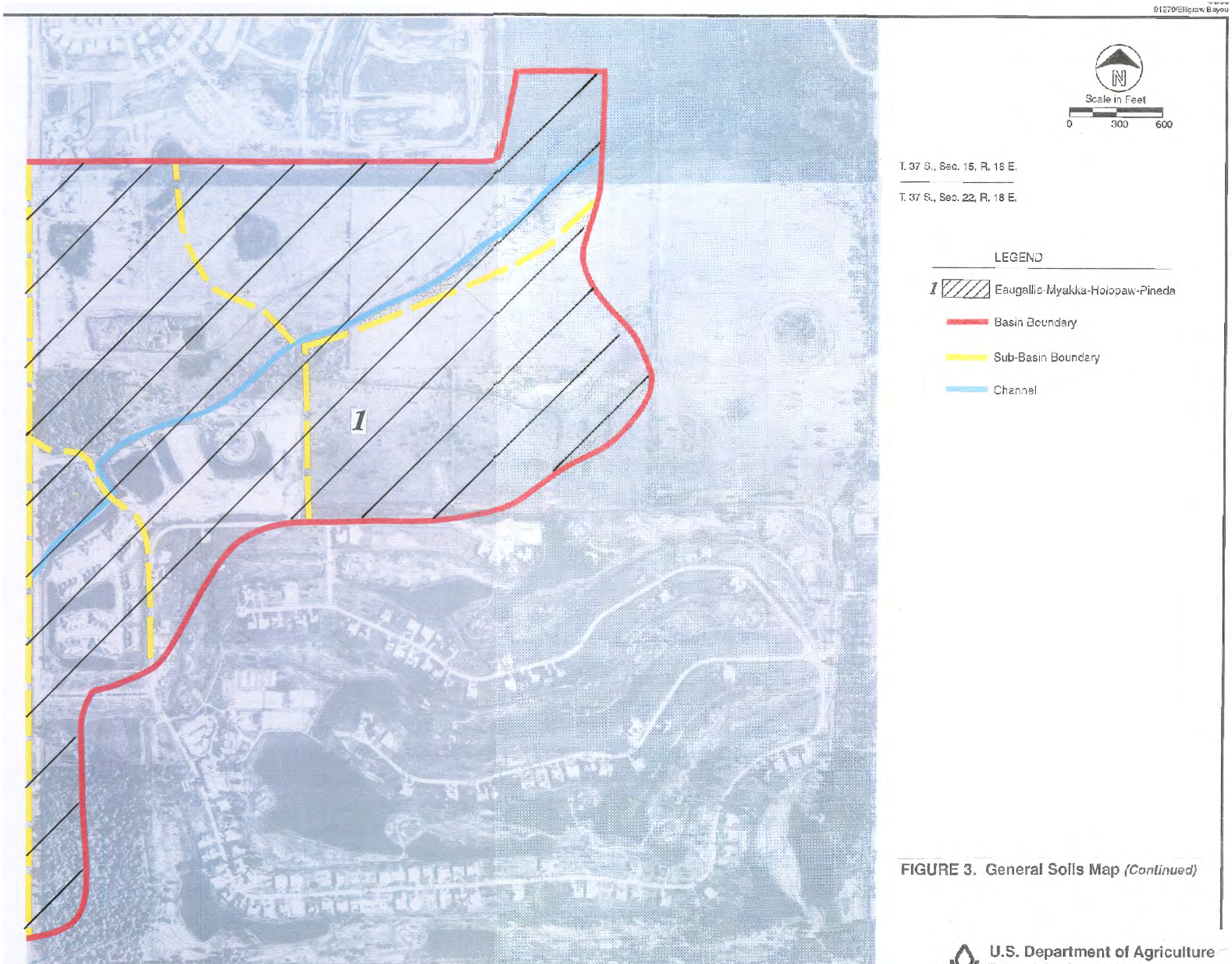

FIGURE 3. General Soils Map *(Continued)*

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SOIL CONSERVATION SERVICE

Natural Values

Naturally the study area was characterized by broad, low pine flatwoods, interspersed with fresh water marshes, sloughs, small lakes, and oak-cabbage palm hammocks. Over the years, most of the flatwoods, wetlands, sloughs, and hammocks have been first converted to pastures or managed rangelands and then suburban development. This pasture conversion began in the upper reaches of the watershed while the suburban development began at the outlet of Elligraw Bayou. Development has spread upward and throughout the watershed to the point of almost total development typical of suburban areas.

The hammock areas are usually seasonally flooded and still show the vegetative characteristic typical for their native condition; live oaks, cabbage palms, fern species, dahoon holly, and red maples.

The marsh and slough areas, where not excavated for stormwater storage or ditched to provide drainage, are generally small, scattered, and very poorly drained. The soil is saturated or covered with water for long periods during the year. Characteristic marsh plants occurring in these areas include maidencane, pickerelweed, smartweeds, arrowheads, sawgrass, fireflag, and an abundance of cattail. Characteristic plants occurring in sloughs are little blue maidencane, wiregrass, yellow-eye grass and a variety of sedges.

Maps classifying and locating wetlands have been prepared by the National Wetlands Inventory, U.S. Fish and Wildlife Service, and are available to the general public.

The study area runs approximately 1.8 miles eastward from Sarasota Bay and laterals northward at the midpoint of the main channel for about one-half mile. The area is predominantly suburban development of typically quarter-acre lots and it includes two eighteen-hole golf courses. There are many small excavated ponds and lakes under five acres in size that provide important benefits through storage and water quality improvement of stormwater.

Due to the highly amended wetlands and sprawling suburban development, wildlife habitat and corridors are practically non-existent; however, some wetland and upland wildlife values are realized by a variety of wading birds, such as herons, Florida sandhill cranes, wood storks, ibis and egrets. Woodpeckers, owls, numerous songbirds, turtles, frogs and snakes, raccoons, opossums, skunks, rabbits, and armadillo also derive value from these wetland and upland systems. An occasional fox has also been seen. All of these species have had to adapt to an intensive human presence.

The fisheries resource includes species such as largemouth bass, several species of sunfish, catfish, small minnows, and gar. Almost all of the fish populations are stocked in the ponds and lakes within the watershed and provide recreational fishing for individuals, but water quality must be taken into account before consumption. The fish serve as a basis of the flood chain for many of the other wildlife species occurring in the area.

Threatened or endangered species whose range and habitat needs indicate that they may occur in the area include the bald eagle, eastern indigo snake, wood stork, and the Florida sandhill crane. See Table 3 for a complete listing of Threatened and Endangered species in Sarasota County, Florida.

Table 3 -- THREATENED OR ENDANGERED SPECIES
Sarasota County

Common Name	Scientific Name
American Alligator	Alligator mississippiensis
Scrub Jay	Aphelocoma coerulescens
Curtis Milkweed	Asclepias curtissii
Ivory Billed Woodpecker	Campephilus principalis
West Coast Prickly Apple	Cereus qracilis
Kirkland's Warbler	Dendroica kirtlandii
Eastern Indigo Snake	Drymarchon corais couperi
Hawksbill Turtle	Eretmochelys imbricata imbricata
Beach Creeper	Ernodia littoraiis
Arctic Peregrine Falcon	Falco pereqrinus tundrius
Southeastern Kestrel	Falco sparverius paulus
Florida Panther	Felis concolor coryi
Florida Sandhill Crane	Grus canadensis pratensis
Bald Eagle	Haliaeetus leucocephalus
Wood Stork	Mycteria americana
Hand Adder's Tongue Fern	Ophioglossum palmatum
Red-Cockaded Woodpecker	Picoides borealis
Crested Caracara	Polyborus plancus
Royal Tern	Sterna antillarum
Least Tern	Sterna dougallii
West Indian Manatee	Trichechus manatus latirostris
Florida Black Bear	Ursus americanus floridanus
Bachman's Warbler	Vermivora bachmanii

Landuse and Development Trends

Migration to the Sunbelt brings approximately 873 new residents per day from other parts of the United States to Florida. Due to the mild oceanic and subtropical climate, proximity to the calm gulf beaches, availability of housing, and other natural values, the study area has experienced a rapid population growth increase during recent years. There has been a 358% increase in the population of Sarasota County since 1960. The population swells by an additional 20 to 25 percent during the winter and spring "tourist season."

FLOOD PROBLEMS

Most of the high frequency floods (2, 5, 10 year events) are from short duration, high intensity afternoon or evening thundershowers, occurring during June to September. Flooding from December through May generally occurs from less frequent, longer duration frontal-type storms. Flooding, resulting from tidal fluctuation, is not addressed in this report.

Flood Potential

Seasonal flooding occurs in low areas throughout the study area. During periods of intense or prolonged rainfall, particularly during the summer rainy season, the water table rises above ground surface on many of the soils and localized flooding occurs as the natural sloughs, marshes and ponds fill.

In addition to this seasonal flooding, larger storms occasionally occur. A flood having an average frequency of occurrence on the order of one in 100 years (a 1 percent chance of being equaled or exceeded in any given year) is generally used for criteria when designing highway bridges and other structures within a flood plain. However, floods larger than the 100-year flood can and will occur. Floodwater elevations and peak discharges were generated for floods with a 1, 2, 4, 10, 20, and 50 percent chance of occurrence. The peak discharges were computed for an average soil moisture condition.

The rainfall depths for various rainfall frequencies used for the study area are presented in Table 4. Rainfall depths were obtained from "Rainfall Analysis, Southwest Florida Area for Southwest Florida Water Management District." These values were used to develop peak discharges presented in Discharge-Elevation-Frequency Tables Appendix B.

Table 4. Rainfall Frequencies and Depths (for a 24-hour storm), Sarasota County, Florida.

2-year	4.5 inches
5-year	6.0 inches
10-year	7.0 inches
25-year	8.0 inches
50-year	9.0 inches
100-year	10.0 inches

A storm event occurred in June 1992 that resulted in large scale flooding. The rainfall associated with this event was approximately 18.3 inches over a three-day period which was estimated to be equal to a storm with a 100-year recurrence interval. Calibration of the HEC-1 and HEC-2 models were performed using rainfall distribution data and high water elevations provided by Sarasota County from this storm event. The rainfall distribution data is contained in Table 5: 1-Hour Rainfall Totals for June 23-26, 1992 and was provided by Kimmerly-Horn and Associates, Inc., from a rain gage located in the Palmer Ranch Development. The water surface profiles used for this calibration are shown in Appendix C.

Table 5 -- 1-Hour Rainfall Totals for June 23-26, 1992

Hour	23rd	24th	25th	26th
0				
1	0.00	0.00	0.00	0.10
2	0.00	0.00	0.12	0.12
3	0.00	0.12	0.01	0.00
4	0.00	0.17	0.00	0.02
5	0.00	1.24	0.00	0.00
6	0.00	0.04	0.00	0.00
7	0.00	0.04	0.00	0.00
8	0.23	0.60	0.57	0.11
9	0.00	0.02	0.23	0.10
10	0.00	0.04	1.01	0.60
11	0.00	0.09	0.91	1.30
12	0.00	0.10	0.54	0.35
13	0.00	0.03	0.28	0.80
14	0.03	0.00	0.43	0.00
15	0.04	0.07	0.15	0.07
16	0.11	0.18	0.21	0.03
17	0.03	0.05	0.05	0.00
18	0.00	0.01	0.86	0.00
19	0.00	0.00	1.75	0.00
20	0.00	0.00	1.89	0.00
21	0.17	0.00	0.42	0.00
22	0.50	0.00	0.03	0.00
23	1.33	0.00	0.00	0.00
24	0.00	0.00	0.00	0.00
	2.44"	2.80"	9.47"	3.60"

Flood Tables (Appendix B)

Information on the possibility of future floods of various magnitudes and the extent of flooding which might occur is included for the study area. Tables showing the elevations of flood events are included in Appendix B for selected cross sections of Elligraw Bayou and Elligraw Bayou, Lateral 1. Cross sections noted in the Discharge-Elevation-Frequency Data Tables, which are not shown on the flood profile figures, can be located by using the stationing of that cross section to locate its position on the flood profiles in Appendix C.

Flood Profiles (Appendix C)

Flood profiles for various storm frequencies are included in Appendix C of this report with bridge and culvert cross sections located on the profiles. The flood profiles show the water surface elevations of the 2, 5, 10, 25, 50, and 100-year frequency floods for present conditions. Included on the profiles are elevations of the stream bed, pertinent bridge and roadway elevations, and other location data. The profile stationing is in terms of stream distance in feet and is based upon channel flow distances measured from the 1979 flight of aerial photomaps supplied by the Southwest Florida Water Management District. Station 0+00 of Lateral 1 is the confluence point with Elligraw Bayou (Station 40+86). Flood depths for computed frequencies can be estimated at any location from the water surface profiles.

Flood Hazard Area Maps (Appendix E)

Flood hazard area maps showing the areas flooded by the base flood (100-year frequency flood) are included in this report in Appendix E. The shaded areas on this map are projected to be flooded by the base flood.

Actual dimensions measured on the ground may vary slightly from those measured on the flood hazard area maps of this report due to map scale and reproduction limitations. Due to scale, small raised areas such as houses built on earth pads will not be detectable. The shaded areas represent stream overflow from the stream only. The filling of depressions with rainfall will also occur.

FLOOD PLAIN MANAGEMENT ALTERNATIVES

Flood elevations at locations along the streams may be determined by using the aerial maps, tables, and profiles presented in the appendices to this report. This information will permit local units of government to implement flood plain management programs which recognize potential flood hazards. Such programs usually limit flood-prone areas to specific uses that would not result in serious economic loss or loss of life during flood events. Building codes may preclude the flood plain from being used for housing, or it could require that houses be constructed at a specific height above certain frequency flood elevations by building on earth pads or pilings.

Flood damage reduction can only be achieved through proper recognition of the hazards associated with flood plain development. Flood damages can be minimized by careful planning and proper flood plain management. Flood plain management programs can contain both nonstructural and structural measures.

Nonstructural Measures

Nonstructural measures do not prevent flooding. These measures reduce the threat of damage or loss of life from flooding by regulating development in the flood plains or by flood proofing existing structures.

Many units of government choose to limit development within a designated floodway. Land use within the floodway would include agricultural and open space type-recreation such as golf courses and parks. Zoning to allow only these types of land uses will limit loss and damage during flooding. In addition, buildings and other structures will limit the stream's ability to expand onto the flood plain during a flooding event and possibly increase the depth of flooding that occurs. Development within the flood plain decreases flood storage and increases flood stages.

Floodproofing is the use of permanent, contingent, or emergency techniques to either prevent flood waters from entering buildings or to minimize the damages from water that does enter. Some of the techniques involve using water-tight seals, closures or barriers; using water-resistant materials; and temporarily relocating the contents of a building, or elevating the structure. Elevating a structure means raising it on fill, piers, or pilings so that it is above expected flood levels.

Structural Measures

Structural measures can be installed to reduce or prevent the occurrence of flooding. These measures can range from maintenance of road ditches and drainage canals to the construction of flood water retarding structures (impoundments).

Maintaining road ditches culverts and drainage canals so that they are free of debris and woody vegetation allows the water to flow freely thereby reducing flooding.

Floodwater retarding structures are earthen structures that store runoff and gradually release flow down stream, the decreased flowrate downstream can result in floodwater protection for downstream areas. These structures should be strategically located to intercept, store, and gradually release the runoff or drainage water from drainage basins where downstream flooding is a problem.

Drainage canals can also be altered to improve their flow characteristics by straightening, enlarging and/or lining the channel.

Structural measures can also include the replacement of existing structures that have inadequate capacity with larger capacity structures.

The specific measures mentioned above are not an inclusive list of possible approaches. We recommend that the study data be used to evaluate the need, potential locations and design of any planned structural improvements.

STUDY RESULTS AND RECOMMENDATIONS

Normally, urban drainage systems (canals, culverts, etc.) are designed to carry the flood flows from a 5 to 10-year frequency rainfall with building floor elevations set above the 100-year flood elevation. This would cause minor flooding of roads and streets but protect the buildings from flooding.

Results of this study show that for existing conditions, the storm sewer (station 2+89 to station 14+04), weir (station 14+11), channel (from station 14+04 to station 25+54) and culvert at Biltmore Drive have insufficient capacity to prevent homes from being flodded from a 100 year storm event. The capacity of the channel system from Biltmore Drive to the outlet is less than the peak discharge from a 2 year storm. This results in frequent nuisance flooding of the streets and homes in the reach from 2+89 to station 25+54. Any significant reductions in flood elevations will require some combination of the following alternatives:

1. Replace existing 3 foot by 6 foot archpipe storm sewer from station 2+89 to station 14+04 of Elligraw Bayou with sufficient capacity for a 10 year, 24-hour storm event.

2. Remove or replace weir structure at station 14+11.

3. Improve existing channel from Station 14+11 to Biltmore Drive by widening and/or deepening.

4. Replace culvert under Biltmore Drive with a larger structure.

5. Development of existing greenbelt areas should be restricted to uses similar to golf courses, parks, and pastures. These uses avoid restricting the flood plain and reduce damage potential.

6. Implement community information workshops to educate landowners in the flood plain about various flood proofing techniques.

7. Review the existing stormwater discharge rules to determine if they are providing adequate protection to landowners that will be impacted by future development.

Implementation of recommendations 1 through 4 above will be needed to reduce the frequency of flooding from station 2+89 to station 25+54. However, it is important to note that <u>implementation of any one of the recommendations 1 through 4 by itself will provide only marginal reductions in flood elevations</u>. The final recommendation to reduce flooding will require a more detailed engineering analysis that include considerations such as landrights, landowners' desires, economics, etc. Implementation of items 5 through 7 will protect the landowners from increased flooding due to future development and provide methods to reduce potential damage.

GLOSSARY OF TERMS

Bridge Area -- The effective hydraulic flow area of a bridge opening accounting for the presence of piers, attached conduits, and skew (alignment), if applicable.

Channel -- A natural or artificial water course of perceptible extent with definite bed and banks to confine and conduct continuously or periodically flowing water.

Flood -- An overflow of water on lands not normally covered by water. Floods have two essential characteristics: the inundation of land is temporary: and the land is adjacent to and inundated by overflow from a river, stream, ocean, lake, or other body of standing water.

Flood Crest -- The maximum stage of elevation reached by the waters of a flood at a given location.

Flood Frequency -- A means of expressing the probability of flood occurrences as determined from a statistical analysis of representative streamflow or rainfall and runoff records. It is customary to estimate the frequency with which specific flood stages or discharges may be equalled or exceeded, rather than the frequency of an exact stage or discharge. Such estimates by strict definition are designated "exceedance frequency", but in practice the term discharge is usually expressed as occurring once in a specified number of years. Also see definition of "recurrence interval." For example, see "100-year Flood" below:

> 100-year flood - A flood having an average frequency of occurrence in the order of once in 100 years. It has a 1 percent chance of being equalled or exceeded in any rainfall and runoff characteristics in the general region of the watershed.

Flood Hazard Area -- Synonymous with Flood Plain (general). Commonly used in reference to flood map.

Flood Peak -- The highest stage or discharge attained during a flood event; also referred to as peak stage or peak discharge.

Flood Plain (general) -- The relatively flat area or low lands adjoining the channel of a river, stream, or watercourse; ocean, lake, or other body of standing water which has been or may be covered by floodwater.

Flood Plain (specific) -- A definitive area within a flood plain (general) or flood-prone area known to have been inundated by a historical flood, or determined to be inundated by floodwater from a potential flood of a specific frequency.

Flood Prone Area -- Synonymous with Flood Plain (General)
Flood Profile -- A graph showing the relationship of water surface elevation to stream bed. It is generally drawn to show the water surface elevation for the peak of a specific flood, but may be prepared for conditions at a given time or stage.

Floodway -- The minimum width from the channel center required to carry a designated frequency flood with a designated increase in the water surface elevation. Zoning within the floodway generally allows for agricultural uses, open space type recreation areas such as golf courses and parks and other similar uses.

Floodway Fringe -- That part of the flood plain which is not required to carry a designated frequency flood with a designated increase in the water surface elevation. Zoning within the floodway fringe generally allows for commercial and private home building as long as the fill allows adequate elevation from flooding.

Hydraulics -- The science that deals with the laws governing water or other liquids in motion and their applications in engineering.

Hydrology -- The science that deals with the occurrence and behavior of water in the atmosphere, on the ground, and underground. Rainfall intensities, rainfall interception by trees, effects of crop rotations on runoff, floods, droughts, the flow of springs and wells, are some of the tropic studied by a hydrologist.

Hydrologic Boundary -- The divide separating adjoining watersheds

Potential Flood -- A spontaneous event (natural phenomenon) capable of occurring from a combination of meteorological, hydrological, and physical conditions: the magnitude of which is dependent upon specific combinations. See Flood and Flood Frequency.

Recurrence Interval -- The average number of years within which a given event will be equaled or exceeded. A 50-year <u>frequency</u> flood has a 50-year recurrence interval.

Runoff -- That part of precipitation as well as any other flood contributions, which appears in surface streams of either perennial or intermittent form.

Stream Bed -- The lowest part of the stream channel (either in a constructed cross section or a natural channel). Bottom elevations at a series of points along the length of a stream may be plotted and connected to provide a stream bottom profile. (This is often referred to as the "stream bed" and is so designated on the flood profiles in Appendix A).

Stream Channel Flow -- That water which is flowing within the limits of a defined watercourse.

Structural Bottom of Opening -- The lowest point of a culvert or bridge opening with a constructed bottom through which a stream flows that could tend to limit the stream channel bottom to that specific elevation. This structural bottom may be covered with sediment or debris which further restricts the size of the opening.

Watershed -- A drainage basin or area which collects and transmits runoff usually by means of streams and tributaries to the outlet of the basin.

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APPENDIX A

INVESTIGATION AND ANALYSIS

The SCS curve number method with SCS dimensionless unit hydrograph was used in conjunction with Modified Puls and Level-Pool Reservoir Routing methods to determine flood discharges for the 2, 5, 10, 25, 50, and 100-year frequency storms using a DELMARVA Type III rainfall distribution in the modified COE HEC-1 computer program. The discharges that were generated were then used in the COE HEC-2 computer program to determine water surface elevations for each frequency storm. Channel storage routing was added to the modeling procedure by utilizing channel volume output from the COE HEC-2 in the storage routing procedure of the COE HEC-1 program. The HEC-1 model was calibrated using rainfall data from the June 1992 Storm Event and by adjusting lag time. Input included field data collected on cross sections, bridges, culverts, roughness coefficient data, and basin slopes. The roughness coefficient data used were Manning's "n" values, estimated using the method described in "Guide for Selecting Manning's Roughness Coefficients for Natural Channels and Flood plains," Report No. FHWA-TS-84-204, U.S. Department of Transportation, Federal Highway Administration, April 1984. The peak elevation and peak discharge estimates are shown in Appendix B.

Normal bridge flow conditions were assumed in making computations. No consideration was made for openings blocked by debris, flood plain filling or other encroachments which could affect the water surface profile. Computations for this study considered only those features in the flood plain that existed in 1987 and 1991 during the time the field surveys were made. Future watershed and flood plain development and/or stream modification will require adjustment of the water surface profiles.

APPENDIX B

DATA TABLES

Table 7 DISCHARGE – ELEVATION – FREQUENCY DATA

Elligraw Bayou Lateral 1 Tributary

ELLIGRAW BAYOU FPMS

			2 yr peak		5 yr peak		10 yr peak		25 yr peak		50 yr peak		100 yr peak	
X–SECT	Station	DA	WSE	Q	WSE	Q	WSE	Q	WSE	Q	WSE	Q	WSE	Q
EL–11002	190	0.1	15.0	57	15.4	86	15.5	106	15.6	125	15.7	145	15.8	164
* EL–11010	455		15.7		15.7		15.7		15.7		15.7		15.8	
* EL–11030	1633	0.1	16.2	38	16.2	58	16.2	71	16.2	84	16.3	98	16.4	111
EL–11060	2374		16.3		16.3		16.3		16.4		16.6		16.7	

WSE – water surface elevation (ft)
Q – discharge (cfs)
DA – drainage area (sq mi)
* Indicates that the cross section is either a bridge or culvert.

APPENDIX C

FLOOD PROFILES

FIGURE 4. Elligraw Bayou Flood Profile Index Map

U.S. Department of Agricultur
SOIL CONSERVATION SERVIC

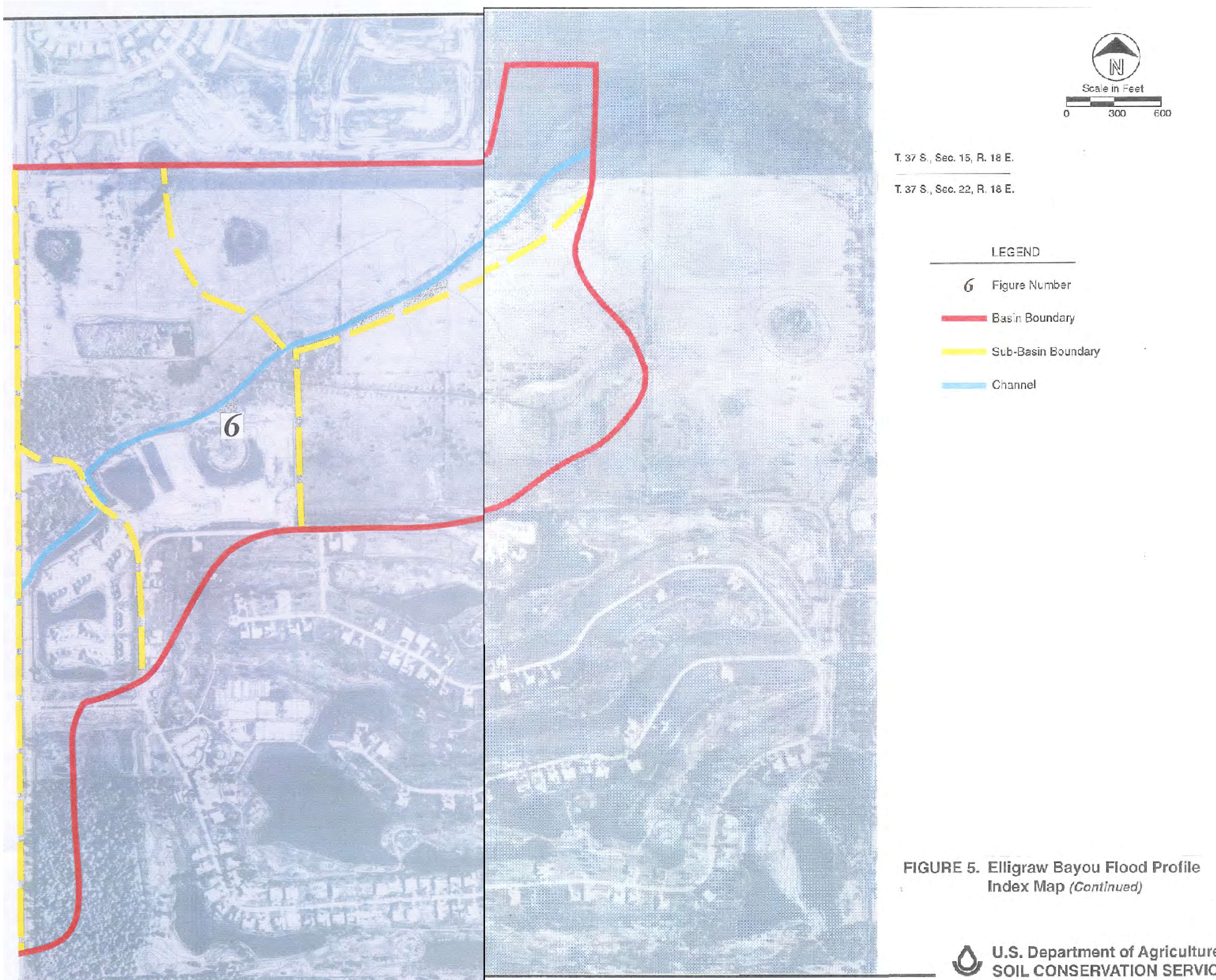


FIGURE 5. Elligraw Bayou Flood Profile Index Map *(Continued)*

U.S. Department of Agriculture
SOIL CONSERVATION SERVICE

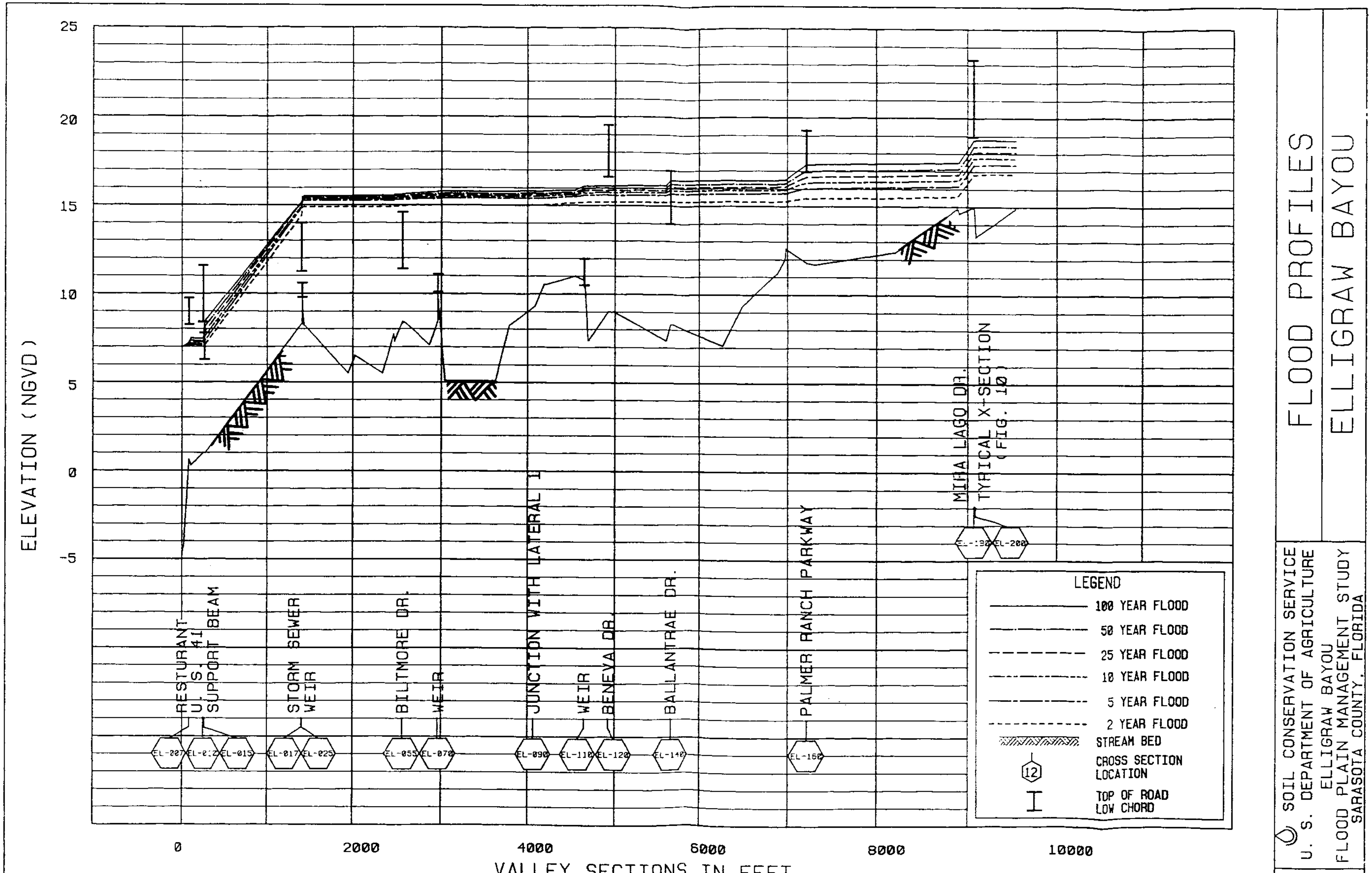
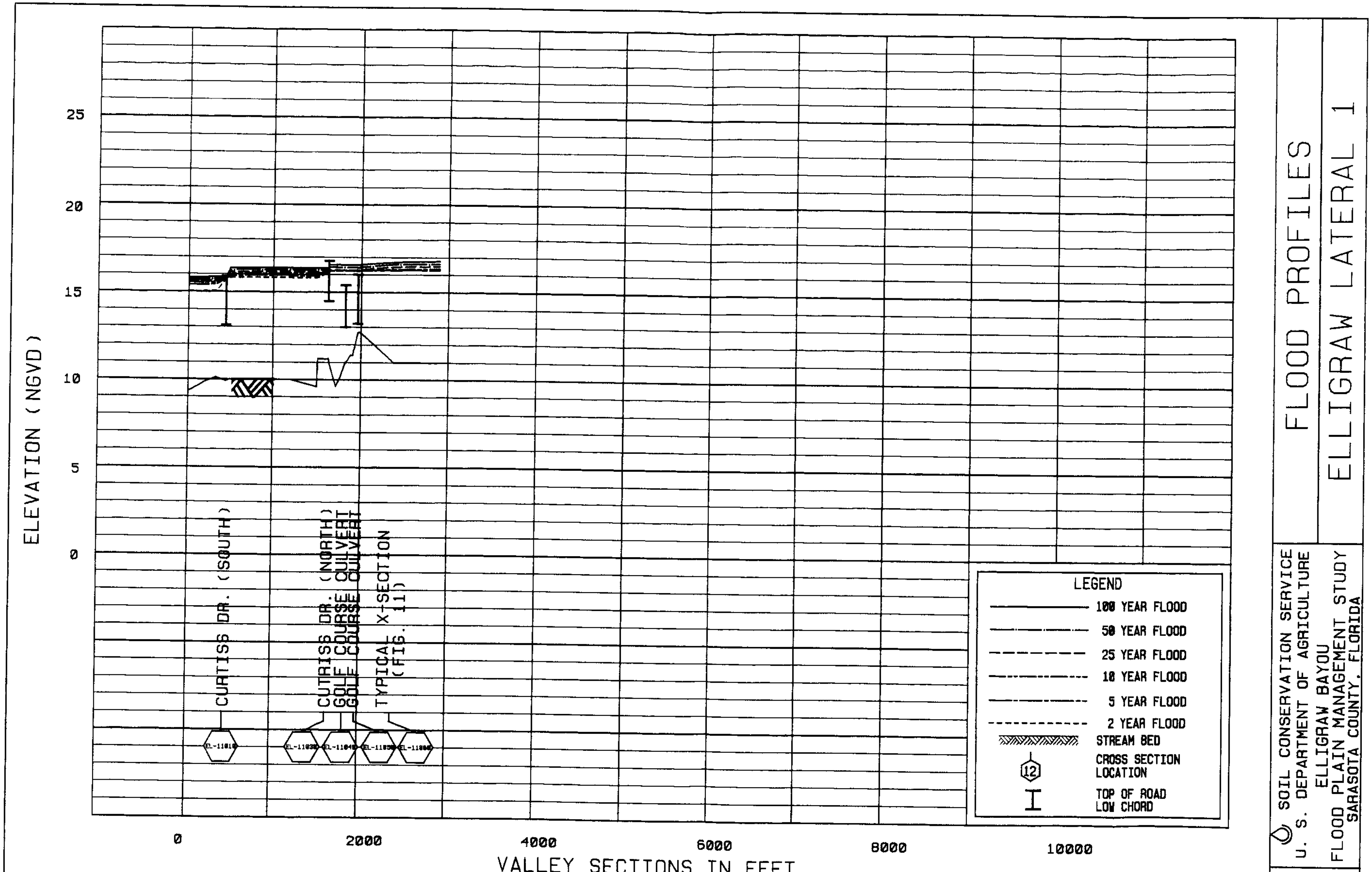
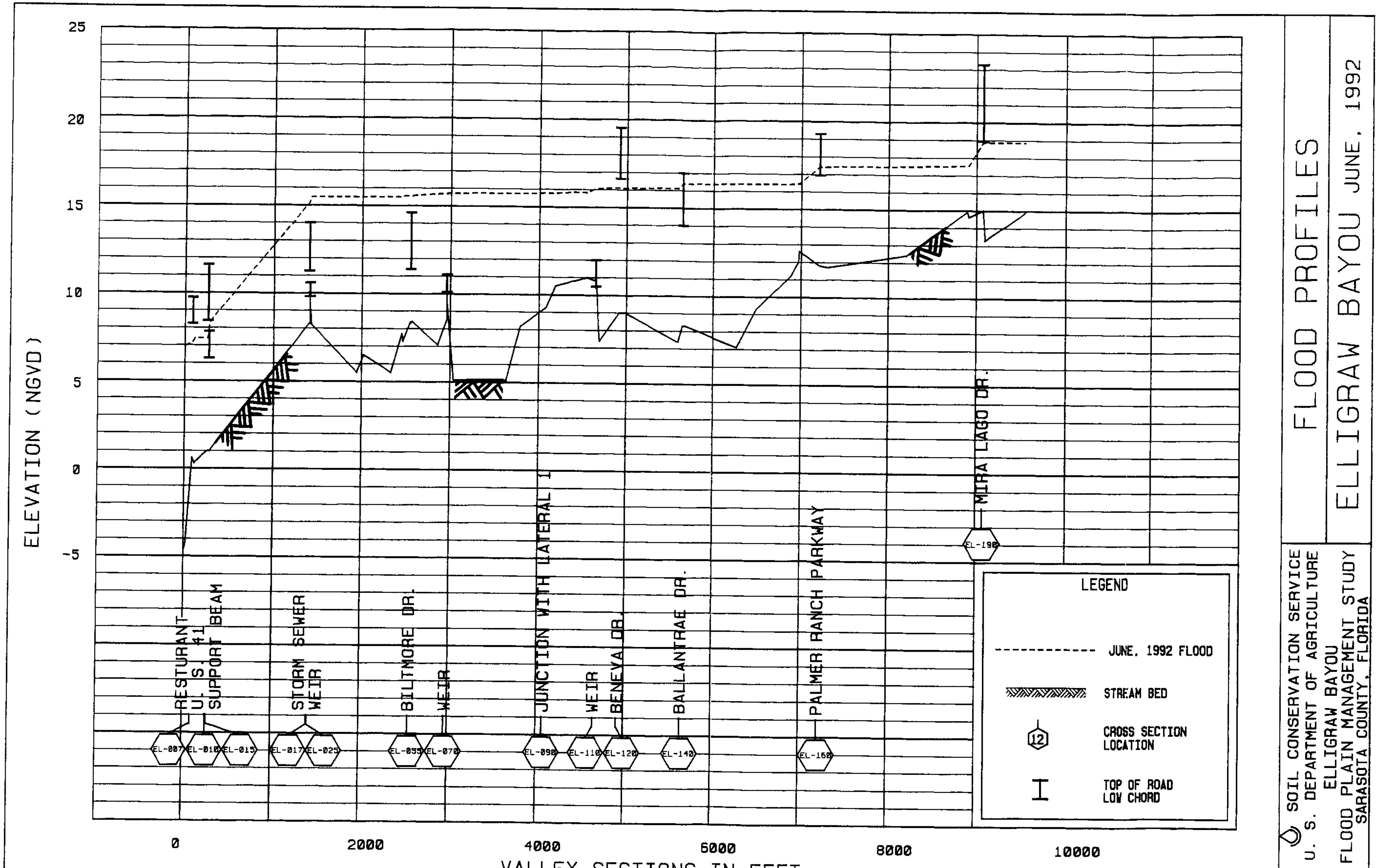

FLOOD PROFILES
ELLIGRAW BAYOU
ELEVATION (NGVD)
VALLEY SECTIONS IN FEET
25
20
15
10
5
0
-5
0
2000
4000
6000
8000
10000
RESTURANT
U. S. 41
SUPPORT BEAM
STORM SEWER
WEIR
BILTMORE DR.
WEIR
JUNCTION WITH LATERAL 1
WEIR
BENEVA DR.
BALLANTRAE DR.
PALMER RANCH PARKWAY
MIRA LAGO DR.
TYPICAL X-SECTION
(FIG. 10)
LEGEND
100 YEAR FLOOD
50 YEAR FLOOD
25 YEAR FLOOD
10 YEAR FLOOD
5 YEAR FLOOD
2 YEAR FLOOD
STREAM BED
CROSS SECTION LOCATION
TOP OF ROAD
LOW CHORD
SOIL CONSERVATION SERVICE
U. S. DEPARTMENT OF AGRICULTURE
ELLIGRAW BAYOU
FLOOD PLAIN MANAGEMENT STUDY
SARASOTA COUNTY, FLORIDA

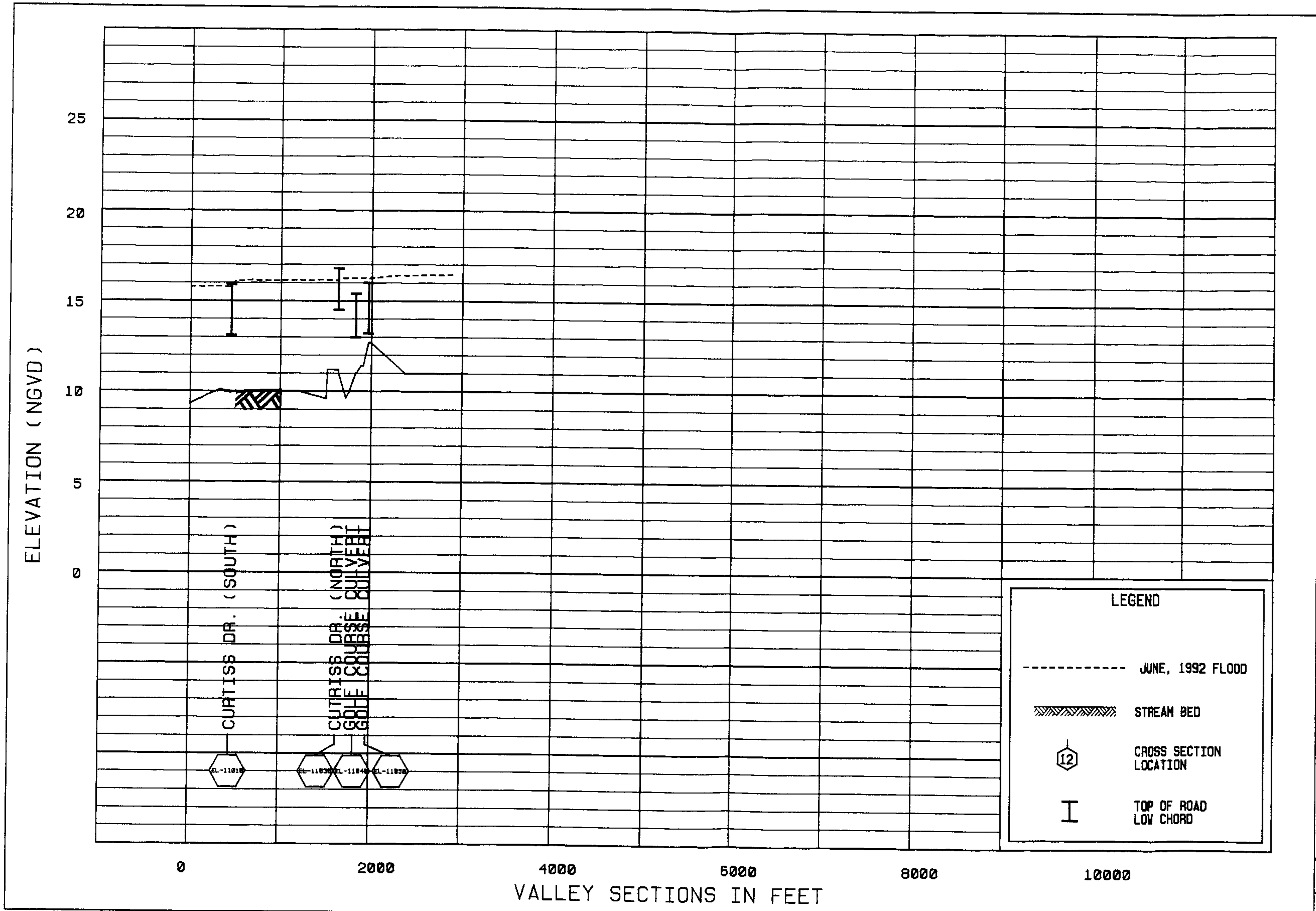
FIG. 6


25
20
15
10
5
0
ELEVATION (NGVD)
0
2000
4000
6000
8000
10000
VALLEY SECTIONS IN FEET
CURTISS DR. (SOUTH)
CUTRISS DR. (NORTH)
GOLF COURSE CULVERT
GOLF COURSE CULVERT
TYPICAL X-SECTION
(FIG. 11)
LEGEND
100 YEAR FLOOD
50 YEAR FLOOD
25 YEAR FLOOD
10 YEAR FLOOD
5 YEAR FLOOD
2 YEAR FLOOD
STREAM BED
CROSS SECTION LOCATION
TOP OF ROAD
LOW CHORD
FLOOD PROFILES
ELLIGRAW LATERAL 1
SOIL CONSERVATION SERVICE
U. S. DEPARTMENT OF AGRICULTURE
ELLIGRAW BAYOU
FLOOD PLAIN MANAGEMENT STUDY
SARASOTA COUNTY, FLORIDA
FIG. 7



FLOOD PROFILES
ELLIGRAW BAYOU JUNE, 1992
SOIL CONSERVATION SERVICE
U. S. DEPARTMENT OF AGRICULTURE
ELLIGRAW BAYOU
FLOOD PLAIN MANAGEMENT STUDY
SARASOTA COUNTY, FLORIDA
ELEVATION (NGVD)
VALLEY SECTIONS IN FEET
25
20
15
10
5
0
-5
0
2000
4000
6000
8000
10000
RESTURANT
U. S. 41
SUPPORT BEAM
STORM SEWER
WEIR
BILTMORE DR.
WEIR
JUNCTION WITH LATERAL 1
WEIR
BENEVA DR.
BALLANTRAE DR.
PALMER RANCH PARKWAY
MIRA LAGO DR.
EL-007
EL-010
EL-015
EL-017
EL-025
EL-055
EL-070
EL-090
EL-110
EL-120
EL-140
EL-160
EL-190
LEGEND
JUNE, 1992 FLOOD
STREAM BED
12
CROSS SECTION LOCATION
TOP OF ROAD
LOW CHORD

FIG. 8



FLOOD PROFILES

ELLIGRAW LATERAL 1

JUNE 1992

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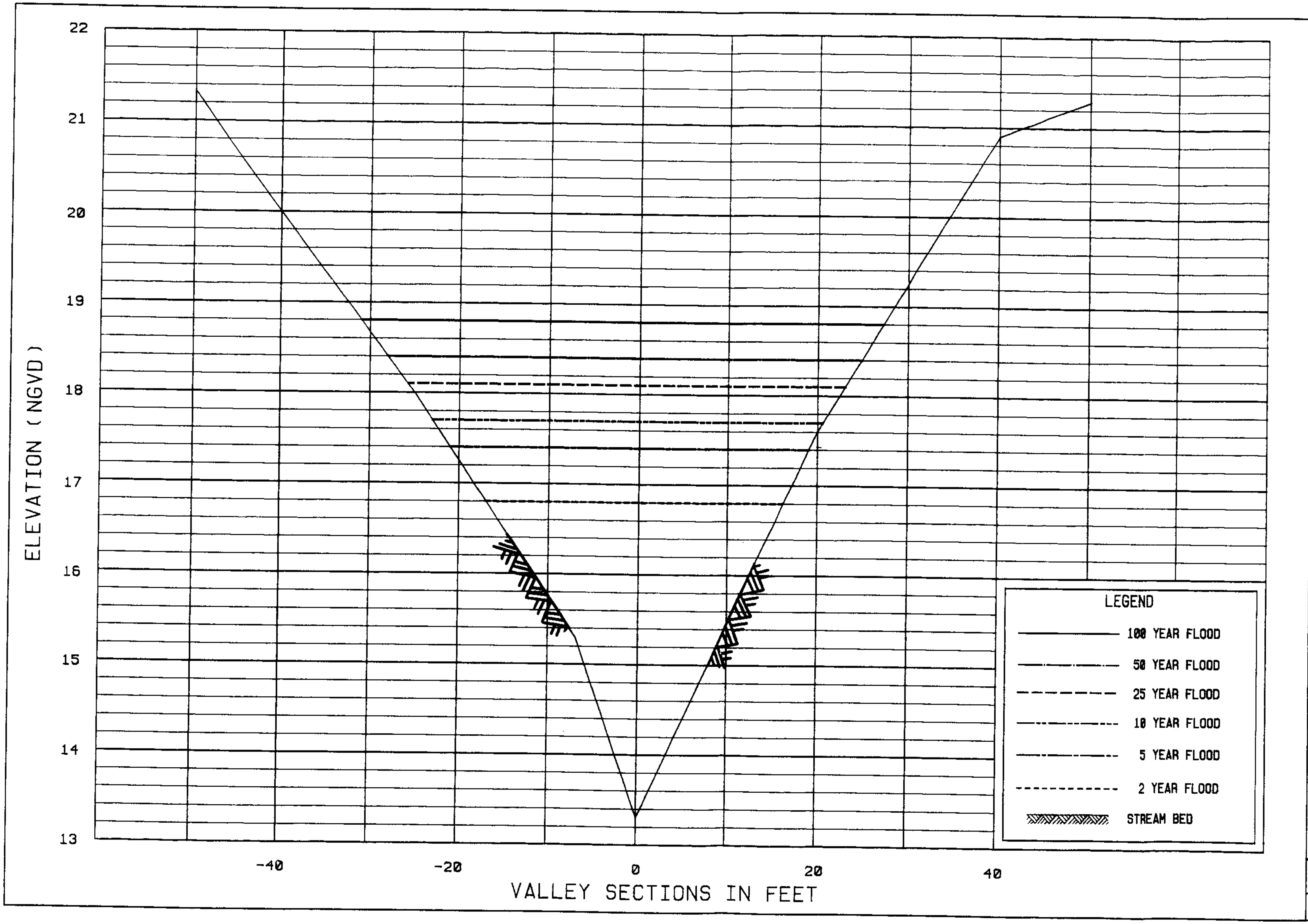
ELLIGRAW BAYOU
FLOOD PLAIN MANAGEMENT STUDY
SARASOTA COUNTY, FLORIDA

FIG. 9

APPENDIX D

TYPICAL VALLEY CROSS SECTIONS



TYPICAL VALLEY SECTIONS

ELLIGRAW BAYOU XSECT # 200

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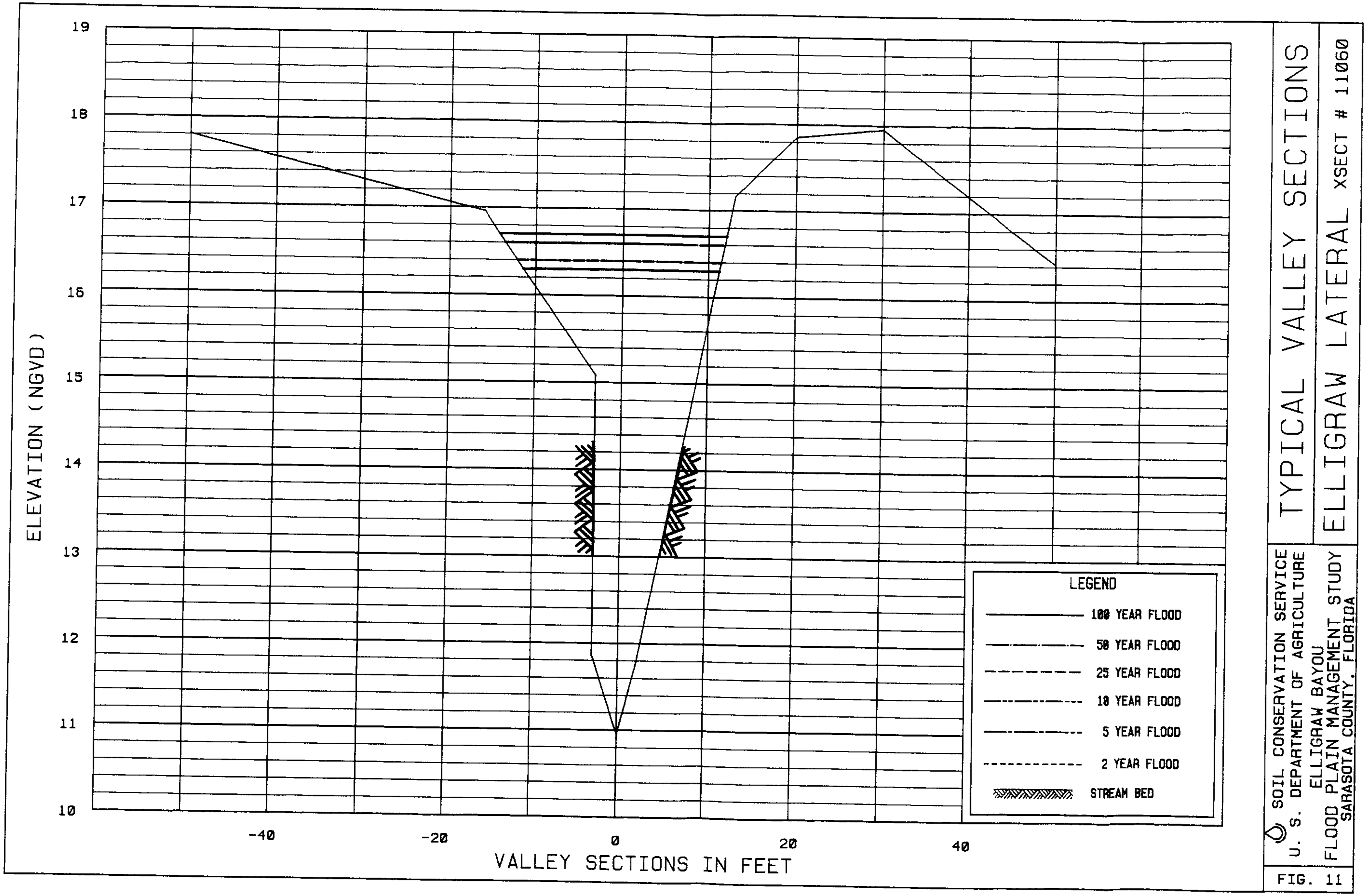
ELLIGRAW BAYOU
FLOOD PLAIN MANAGEMENT STUDY
SARASOTA COUNTY, FLORIDA

FIG. 10


ELEVATION (NGVD)
19
18
17
16
15
14
13
12
11
10
-40
-20
0
20
40
VALLEY SECTIONS IN FEET
LEGEND
100 YEAR FLOOD
50 YEAR FLOOD
25 YEAR FLOOD
10 YEAR FLOOD
5 YEAR FLOOD
2 YEAR FLOOD
STREAM BED
TYPICAL VALLEY SECTIONS
ELLIGRAW LATERAL XSECT # 11060
SOIL CONSERVATION SERVICE
U. S. DEPARTMENT OF AGRICULTURE
ELLIGRAW BAYOU
FLOOD PLAIN MANAGEMENT STUDY
SARASOTA COUNTY, FLORIDA
FIG. 11

APPENDIX E

FLOOD HAZARD MAPS

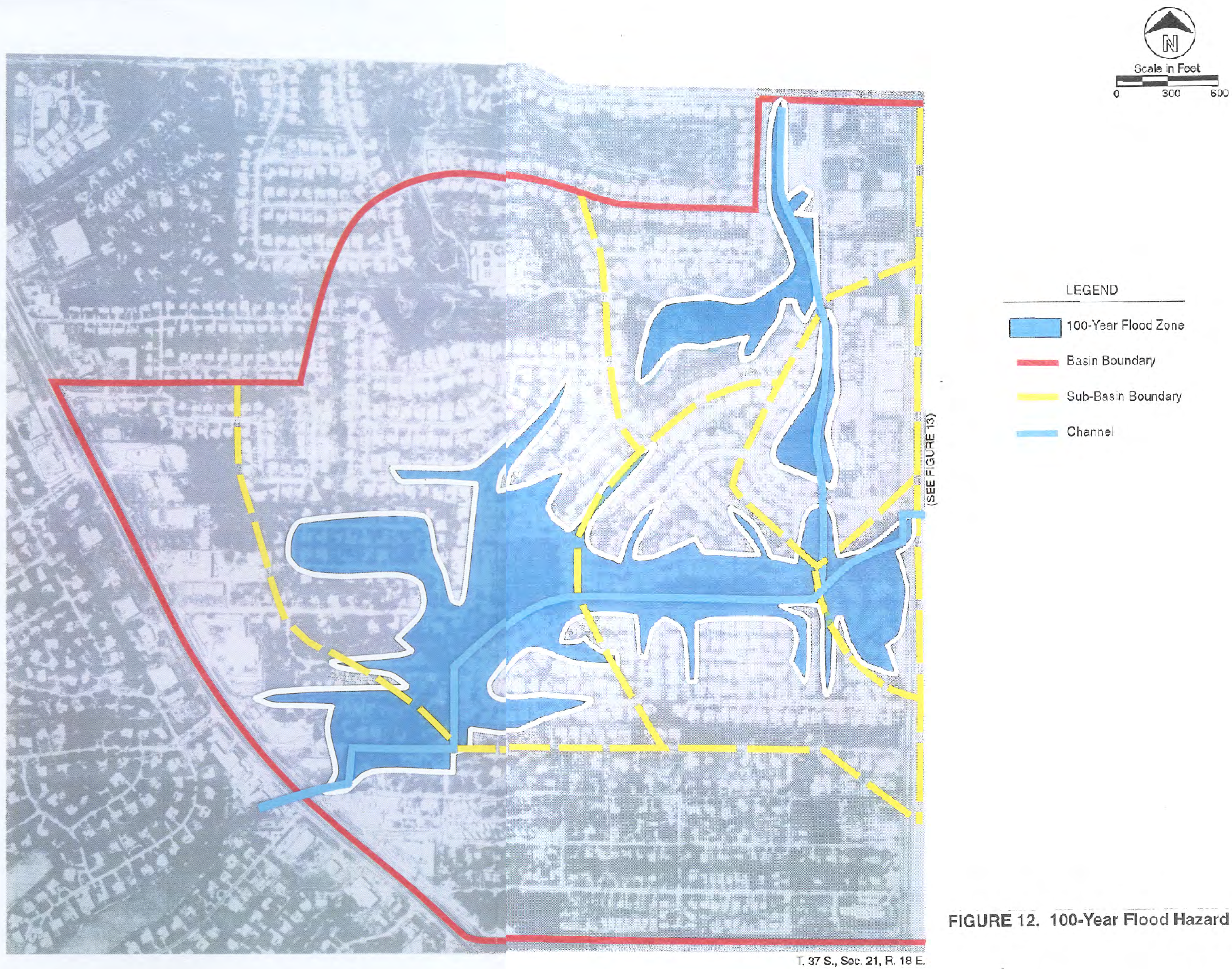


FIGURE 12. 100-Year Flood Hazard Map

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SOIL CONSERVATION SERVICE

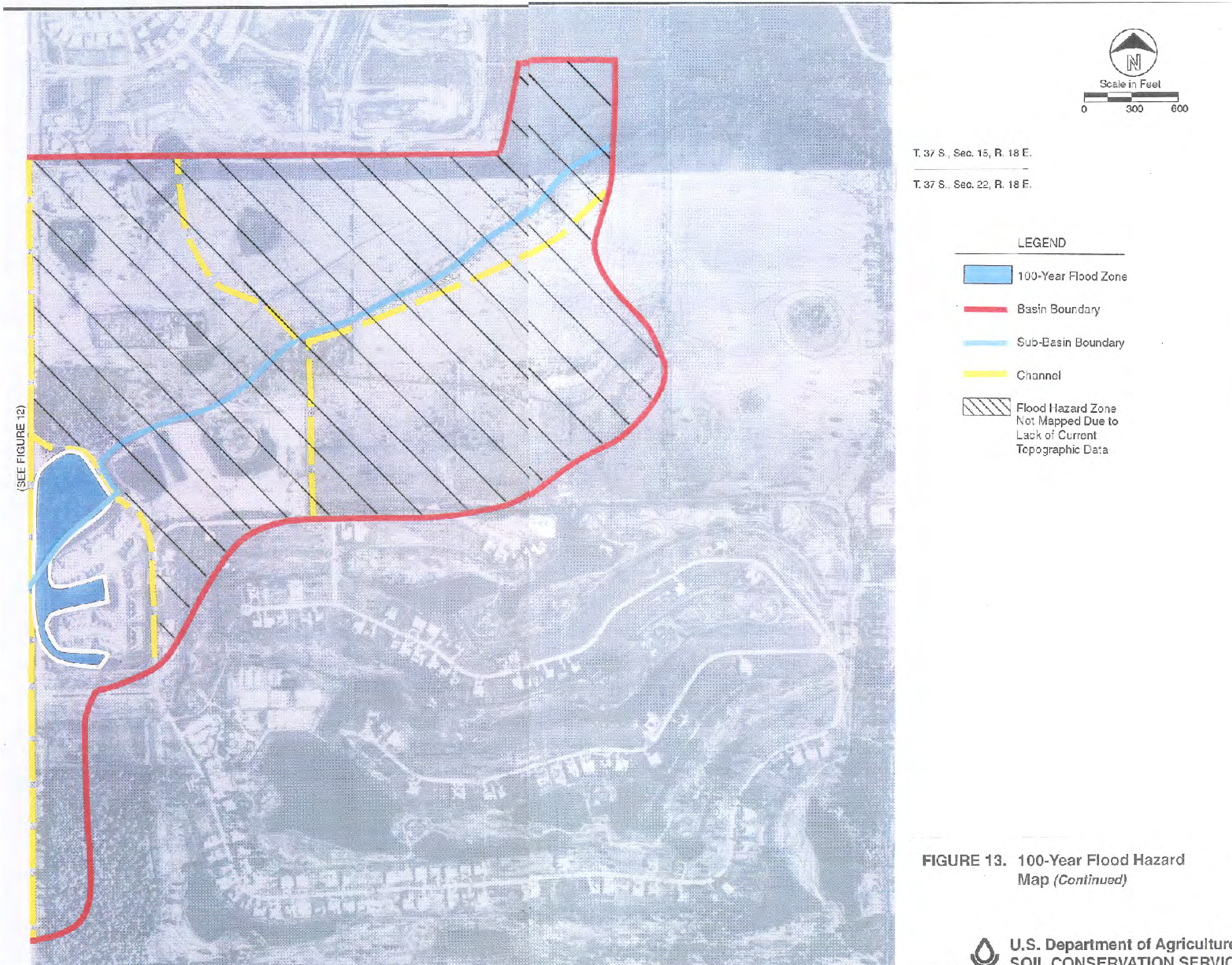

FIGURE 13. 100-Year Flood Hazard Map *(Continued)*

U.S. Department of Agriculture
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